

REMARKS

Claims 21, 24-36, 38-39 and 41-46 are currently pending in this application, with claims 21, 35, and 39 being the only independent claims. Claims 21, 35, and 39 are amended and claims 44-46 are added. Support for the amendments to independent claims 21, 35 and 39 may be found, for example, at paragraph [0019] of the published version of the present application (U.S. Pub. No. 2008/0134680) i.e., “the published application”. Support for new dependent claims 44-46 may also be found, for example, at paragraph [0019] the published application. No new matter has been added. Reconsideration of the above-identified application, in view of the following amendment and remarks, is respectfully requested.

Claims 21-27 and 35-40 stand rejected under 35 U.S.C. §102(b) as unpatentable over U.S. Pub. No. 2003/0172654 (“*Lawheed*”) in view of U.S. Patent No. 4,429,661 (“*McClure*”) and U.S. Patent No. 5,027,602 (“*Glenn*”). Claims 28-34 stand rejected under 35 U.S.C. §103(a) as unpatentable over *Lawheed* in view of *McClure*, *Glen* and WO 85/02881 (“*Lipovetz*”). For the following reasons, reconsideration and withdrawal of these rejections are requested.

Independent claim 21 has been amended to recite, *inter alia*, “the low-pressure expansion device is a roots blower including a suction chamber and being arranged and dimensioned so that the working fluid is expanded therein and heat energy is transformed to mechanical energy”, and “condensing the expanded working fluid in a heat exchanger and injecting at least a portion of the condensed working fluid into the suction chamber of the roots blower during the expansion of further working fluid”. Independent claims 35 and 39 have been correspondingly amended. Support for the amendments to independent claims 21, 25 and 39 may be found, for example, at paragraph [0019] of the published application. No new matter has been added. The combination of the cited art fails to teach or suggest these limitations.

The Examiner (at pg. 2 of the Office Action) has acknowledged that the combination of *Lawheed* and *McClure* fails to teach or suggest “a portion of the condensed working fluid is supplied into the roots blower”, and cites *Glen* for this feature.

Applicants, however, respectfully disagree that the combination of *Lawheed*, *McClure* and *Glen* provides a method of converting heat energy generated in an evaporator to mechanical energy by expanding an evaporated working fluid that includes “condensing the expanded working fluid in a heat exchanger and injecting at least a portion of the condensed working fluid into the suction chamber of the roots blower during the expansion of further working fluid”, as now recited in independent claim 21. Applicants note initially that the suction chamber of a roots blower is not the intake of the expander.

Glen relates to “energy-efficient, mixed phase, high volume/ratio fluid-handling expanders and compressors to a single-component working fluid that exists as a mixture of fine droplets of saturated liquid in saturated vapour” (see col. 2, lines 45-49). Fig. 5 of *Glen* shows a schematic layout of a Carnot engine. *Glen* (col. 4, lines 59-65) explains that the Carnot engine “comprises four primary components: The boiler 10, the expander 12, the condenser 14, and the compressor/pump 16. Boiler 10 is connected to the inlet of expander 12 by a boiler outlet line 13 while the expander outlet for “spent” gas is connected to the condenser inlet via condenser inlet line 15”. However, *Glen* merely teaches that a liquid spray nozzle 20 sprays a portion of condensed fluid into the intake of an expander 12. In the Carnot engine depicted in Fig. 5 of *Glen*, the liquid from the spray nozzle 20 is mixed with the saturated vapor from the boiler 10 in the boiler outlet line 13. *Glen* thus teaches that the mixing of the vapor and fluid in the Carnot engine occurs before the homogenous dual-phase working fluid enters the expander 12 at state point (1) (see, e.g., col. 5, line 36-41; Fig. 5).

Glen provides no hint, teaching or suggestion whatsoever that working fluid is injected into a suction chamber of a roots blower. That is, *Glen* fails to teach or suggest the step of “condensing the expanded working fluid in a heat exchanger and injecting at least a portion of the condensed working fluid into the suction chamber of the roots blower during the expansion of further working fluid”, as recited in now-amended independent claim 21.

As evident from Fig. 1 of applicants’ disclosure, the evaporated working fluid from the evaporator 6 is directed into an intake of the roots blower 2. The portion of the condensed working fluid that is extracted by the separator 3 is also directed into the roots blower. Fig. 1 clearly shows that the vapor and the condensed working fluid are not mixed before entering the roots blower. In fact, the inlet of the vapor and the working fluid are arranged on different sides of the roots blower. By injecting the condensed working fluid directly into the suction chamber of the roots blower, the injected working fluid partially condenses the vapor during heat exchange in the roots blower and, therefore, advantageously increases the effective pressure differential of the expansion for an overall increase in efficiency (see paragraph [0019] of the published application). *Glen* fails to teach or suggest a system that provides these advantageous effects, because the liquid is mixed with the vapor before entering the expander.

Glen, Lawheed and/or *McClure* thus fail to teach or suggest that expanded working fluid is injected into the roots blower directly, i.e., into the suction chamber of the roots blower. Independent claim 21 has been amended to clarify that the condensed working fluid is injected into the suction chamber of the roots blower, i.e., the working fluid is directly injected into the roots blower but not upstream of the roots blower. Thus, the working fluid is condensed in the roots blower, such that the output pressure is reduced and therefore the efficiency of the process is improved. Due to the pressure difference with respect to the heat exchanger coupled to the outlet of the roots blower, the rotors arranged in the roots blower are driven by the expanded

working fluid, and a change in entropy accompanying the expansion is given off as mechanical energy. There is no teaching or suggestion whatsoever in *Glen*, *Lawheed* and/or *McClure* of a device that provides these advantages and functionality.

Moreover, even assuming arguendo that the skilled person would have the motivation or reason to combine the teaching of *Glen* with the teachings of *Lawheed* and/or *McClure* – which in any event they would not – the expressly-recited subject matter of amended independent claim 21 would still not be attained. *Lawheed* and *McClure* utterly fail to teach or suggest that a liquid is injected into the suction chamber of a roots blower. It thus follows that *Lawheed* and *McClure* fail to teach or suggest that a working fluid is injected into the roots blower. As explained above, *Glen* also fails to teach or suggest that working fluid is injected into the suction chamber of a roots blower. The skilled person is thus provided with no motivation or reason to modify the systems of *Lawheed* and *McClure* to inject a working fluid into the suction chamber of a roots blower.

In view of the foregoing, amended independent claim 21 is not obvious in view of *Glen* in combination with *Lawheed* and/or *McClure*, because *Glen* fails to provide what *Lawheed* and *McClure* lack.

Independent claims 35 and 39 include similar limitations and should be allowable for at least the same reasons as is independent claim 21. For example, the skilled person would have no reason to provide a heat exchanger configured to inject at least a portion of condensed working fluid into a suction chamber of a roots blower during the expansion of further working fluid and, thus, the skilled person would not provide an injection opening for enabling such an injection of at least a portion of the condensed working fluid into the suction chamber of the roots blower. Independent claims 35 and 39 are therefore not rendered obvious and unpatentable by the combination of *Lawheed*, *McClure* and *Glen* for *at least* this additional reason.

The Examiner has acknowledged that the combination of *Lawheed*, *McClure* and *Glen* fails to teach or suggest an “absorbent step”, as recited in dependent claims 28-34, and cites *Lipovetz* for this feature.

Applicants, however, respectfully disagree that the combination of *Lawheed*, *McClure*, *Glen* and *Lipovetz* achieves a method for converting heat energy generated in an evaporator to mechanical energy that includes injecting at least a portion of the condensed, expanded and evaporated working fluid into the suction chamber of the roots blower during the expansion of further working fluid, as recited in now-amended independent claim 21. *Lipovetz* discloses a system for converting heat energy of the environment connected to a heat energy source. The disclosure of *Lipovetz* includes two drawings, i.e., Fig. 1 and Fig. 2. There is nothing whatsoever in Fig. 1 and Fig. 2 of *Lipovetz* regarding the condensing step that includes the injection of at least a portion of the condensed, expanded and evaporated working fluid as recited in now-amended independent claim 21. The combination of *Lawheed*, *McClure*, *Glen* and *Lipovetz* thus fails to teach or suggest applicants’ claimed low-pressure expansion device that is a roots blower in which the condensing step of now-amended independent claim 21 is performed, because *Lawheed*, *McClure*, *Glen* and *Lipovetz* make no mention whatsoever of injecting at least a portion of condensed, expanded and evaporated working fluid into the suction chamber of a roots blower. Applicants accordingly assert that dependent claims 28-34 are therefore patentable based on their dependency from independent claim 21.

Reconsideration and withdrawal of the rejections under 35 U.S.C. §103 are therefore in order, and a notice to that effect is respectfully requested.

In view of the patentability of independent claims 21, 35 and 39, dependent claims 24-26, 38-39 and 41-43, as well as new dependent claims 44-46, are also patentable over the prior art for the reasons set forth above, as well as for the additional recitations contained therein.

Based on the foregoing remarks, this application is in condition for allowance. Early passage of this case to issue is respectfully requested.

Should the Examiner have any comments, questions, suggestions, or objections, the Examiner is respectfully requested to telephone the undersigned in order to facilitate reaching a resolution of any outstanding issues.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
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